

Chapter 2 Part B

4.3L V6 engine

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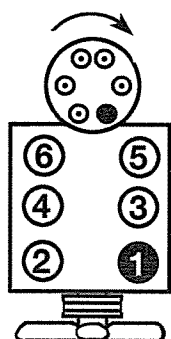
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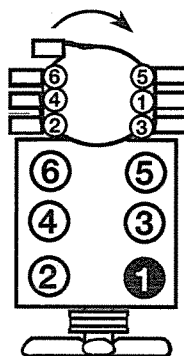
General

Cylinder numbers (front-to-rear)	
Left (driver's) side.....	1-3-5
Right side	2-4-6
Firing order	1-6-5-4-3-2
Displacement.....	262 cubic inches

The blackened terminal shown on the distributor cap indicates the Number One spark plug wire position



FIRING ORDER
1-6-5-4-3-2
with HEI ignition system



FIRING ORDER
1-6-5-4-3-2
with Enhanced Distributor
Ignition (EDI) system

Cylinder numbering and
distributor rotation -
V6 engines

24071-2B-SPECS HAYNES

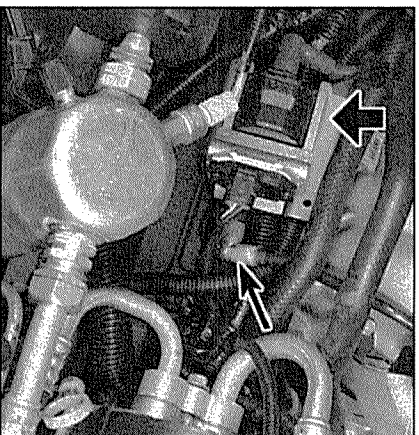
Camshaft

Bearing journal	
Diameter	1.8677 to 1.8697 inches
Out-of-round limit.....	0.001 inch
Lobe lift	
1994 and 1995	
VIN Z	
Intake.....	0.234 inch
Exhaust.....	0.257 inch
VIN W	
Intake.....	0.288 inch
Exhaust.....	0.294 inch
1996 on	
Intake.....	0.2763 inch
Exhaust.....	0.2855 inch
Endplay	0.001 to 0.009 inch

Torque specifications

Valve cover bolts	
1994 and 1995	90 in-lbs
1996 on	106 in-lbs
Intake manifold bolts	
1994 and 1995	
VIN Z (see illustration 6.29a)	
All, except bolt A	35
Bolt A.....	41
VIN W	
Lower.....	35
Upper.....	10
1996 on	
Step 1	26 in-lbs
Step 2	106 in-lbs
Step 3	132 in-lbs
Exhaust manifold bolts/stud	
Step 1	132 in-lbs
Step 2	22
Cylinder head bolts	
1994 and 1995	65
1996 on	
Step 1 (all bolts)	22
Step 2	
Short bolts	Tighten an additional 55-degrees
Medium bolts.....	Tighten an additional 65-degrees
Long bolts.....	Tighten an additional 75-degrees
Timing chain cover bolts	
1994	124 in-lbs
1995 on	106 in-lbs
Camshaft sprocket bolts	21
Balance shaft retainer bolts.....	106 in-lbs
Driven gear bolt	
Step 1	15
Step 2	Tighten an additional 35-degrees
Drive gear retaining stud	144 in-lbs
Rocker arm nuts (bolts on 2000 and later)	20
Vibration damper bolt	70
Hydraulic lifter retainer bolts.....	144 in-lbs
Oil pan	
1994 and 1995	
Bolts.....	100 in-lbs
Nuts.....	204 in-lbs
1996 through 1998	
Bolts.....	204 in-lbs
Nuts.....	216 in-lbs
1999 and later (all)	18
Oil pump bolt	65
Rear main oil seal retainer bolts	132 in-lbs
Flywheel/driveplate bolts.....	75

Ft-lbs (unless otherwise indicated)



3.5 Disconnect the PCV valve (small arrow) and move the coil bracket (large arrow) - pull the heater hoses from their bracket at the rear

1 General information

This Part of Chapter 2 is devoted to in-vehicle repair procedures for the 4.3L V6 engine. All information concerning engine removal and installation and engine block and cylinder head overhaul can be found in Part C of this Chapter.

There are three different fuel systems used on the 4.3L V6 engines covered by this manual; refer to Chapter 4 for more detailed information. Some specifications and procedures in this Chapter vary by the specific version of this same basic engine. If there's any doubt as to which version you have, refer to the Vehicle Identification Number (VIN) that is located on the forward edge of the dashboard on the driver's side. The VIN is visible from outside the vehicle, through the windshield. If the eighth position in the alpha-numeric code is a W, you have the VIN W engine. You could also have a Z code or X code.

The following repair procedures are based on the assumption that the engine is installed in the vehicle. If the engine has been removed from the vehicle and mounted on a stand, many of the steps outlined in this Part of Chapter 2 will not apply.

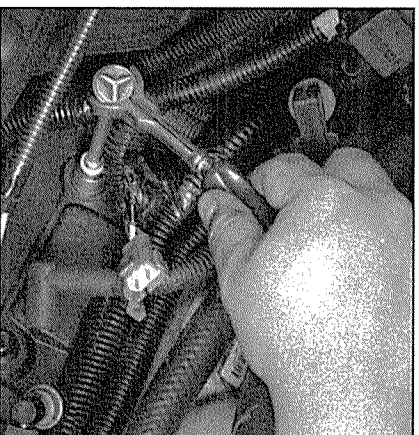
The Specifications included in this Part of Chapter 2 apply only to the procedures contained in this Part. Part C of Chapter 2 contains the Specifications necessary for cylinder head and engine block rebuilding.

2 Repair operations possible with the engine in the vehicle

Many major repair operations can be accomplished without removing the engine from the vehicle.

Clean the engine compartment and the exterior of the engine with some type of pressure washer before any work is done. It will make the job easier and help keep dirt out of the internal areas of the engine.

Remove the hood, if necessary, to



3.7 Remove the three bolts and remove the valve cover

improve access to the engine as repairs are performed (see Chapter 11 if necessary).

If vacuum, exhaust, oil or coolant leaks develop, indicating a need for gasket or seal replacement, the repairs can generally be made with the engine in the vehicle. The intake and exhaust manifold gaskets, timing chain cover gasket, oil pan gasket (on 4WD models only), crankshaft oil seals and cylinder head gaskets are all accessible with the engine in place.

Exterior engine components, such as the intake and exhaust manifolds, the oil pan and oil pump (on 4WD models only), the water pump, the starter motor, the alternator, the distributor and the fuel system components can be removed for repair with the engine in place.

Since the cylinder heads can be removed without pulling the engine, valve component servicing can also be accomplished with the engine in the vehicle. Replacement of the timing chain and sprockets is also possible with the engine in the vehicle.

3 Valve covers - removal and installation

Removal

1 Disconnect the negative cable from the battery. **Caution:** *On models equipped with a Delco Loc II audio system, be sure the lock-out feature is turned off before performing any procedure which requires disconnecting the battery.*

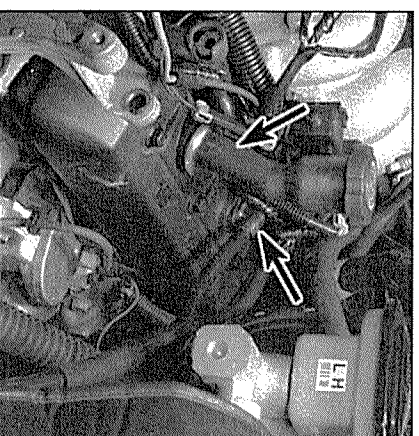
2 Remove the air cleaner assembly (see Chapter 4).

Right side

Refer to *Illustrations 3.5 and 3.7*

3 On 1994 pick-up models, remove the EGR controller and EGR bracket, then tag and disconnect the vacuum lines in the way.

4 On 1994 Blazer and Jimmy models, disconnect the PCV valve from the cover, disconnect the heater pipe at the intake manifold (refer to Chapter 1 for the coolant draining procedure), unclip and lay aside the



3.10 On most models, the PCV valve (right arrow) and hose must be disconnected and moved for left valve cover removal - the oil filler tube (left arrow) easily twists out of the valve cover

wiring harness, unbolt and move the relay bracket bolted to the cowl, pull the spark plug wires from their clips, and disconnect the dipstick tube bracket at the cylinder head and wiggle the tube aside.

5 On 1995 models, disconnect the PCV valve at the valve cover, and unbolt and move the coil bracket (see *illustration*).

6 On 1996 and later models, unclip and move the spark plug wires, disconnect the vent tube, unbolt the wiring bracket at the alternator, and remove the bolt from the brace on the dipstick tube and wiggle the dipstick tube out of the way. The heater hoses can be moved aside without disconnecting them.

7 Remove the three valve cover bolts, then detach the cover from the cylinder head (see *illustration*). **Note:** *If the cover is stuck to the cylinder head, bump one end with a block of wood and a hammer to jar it loose. If that doesn't work, try to slip a flexible putty knife between the cylinder head and cover to break the gasket seal. Don't pry at the cover-to-head joint or damage to the sealing surfaces may occur (leading to oil leaks in the future).*

Left side

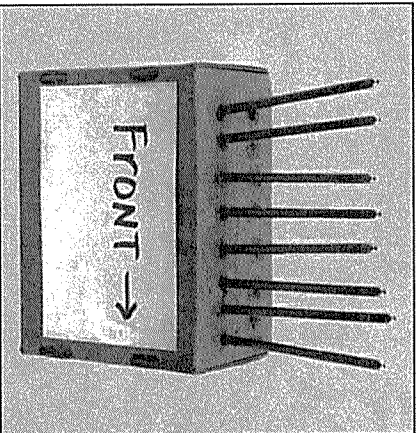
Refer to *illustration 3.10*

8 On 1994 and 1995 pick-up models, remove the power brake booster brace, and disconnect the large vacuum hose to the booster.

9 On 1994 Blazer and Jimmy models, disconnect the heat tube to the air cleaner system, the PCV pipe, the rear alternator bracket and remove the spark plug wires from their clips. Disconnect and move aside the large vacuum hose to the brake booster, and the fuel lines at the TBI unit (refer to Chapter 4).

10 On 1995 Blazer and Jimmy models, disconnect and move aside the PCV hose (see *illustration*).

11 On all 1996 and later models, disconnect and move aside the PCV valve and tube. Unbolt and set aside the air conditioning compressor and bracket (refer to Chapter 3).



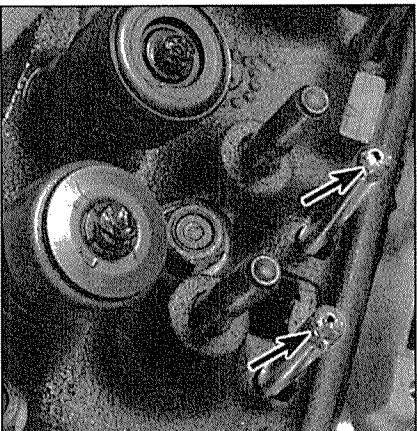
- 4.4 A perforated cardboard box can be used to store the pushrods to ensure that they're installed in their original positions - note the label indicating the front of the engine

DO NOT disconnect the hoses from the compressor. **Warning:** The air conditioning system is under high pressure. DO NOT disassemble any part of the system unless the system has been depressurized. On 1999 and later models, the compressor does not have to be removed, but disconnect and remove the EGR tube, and disconnect the electrical connector at the coolant temperature sensor in the cylinder head.

- 12 Remove the three valve cover bolts, then detach the cover from the cylinder head. **Note:** If the cover is stuck to the cylinder head, bump one end with a block of wood and a hammer to jar it loose. If that doesn't work, try to slip a flexible putty knife between the cylinder head and cover to break the gasket seal. Don't pry at the cover-to-head joint or damage to the sealing surfaces may occur (leading to oil leaks in the future).

Installation

- 13 The mating surfaces of each cylinder head and valve cover must be perfectly clean when the covers are installed. Use a gasket scraper to remove all traces of sealant and old gasket material, then clean the mating surfaces with lacquer thinner or acetone. If there's sealant or oil on the mating surfaces when the cover is installed, oil leaks may develop.
- 14 Clean the mounting bolt threads with a die to remove any corrosion and restore damaged threads. Make sure the threaded holes in the cylinder head are clean - run a tap into them to remove corrosion and restore damaged threads.
- 15 The gaskets should be mated to the covers before the covers are installed. Apply a thin coat of RTV sealant to the cover flange, then position the gasket inside the cover lip and allow the sealant to set up so the gasket adheres to the cover.
- 16 Carefully position the cover(s) on the cylinder head and install the bolts.
- 17 Tighten the bolts in three or four steps to the torque listed in this Chapter's Specifications.



- 4.10 Lube the ends of the pushrods and the valve stems with moly-base grease prior to installation of the rocker arms

- 18 The remaining installation steps are the reverse of removal.
- 19 Start the engine and check carefully for oil leaks as the engine warms up.

4 Rocker arms and pushrods - removal, inspection and installation

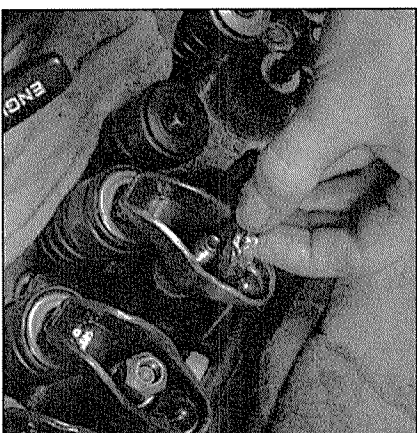
Removal

Refer to illustration 4.4

- 1 Detach the valve cover(s) from the cylinder head(s) (see Section 3).
- 2 Beginning at the front of one cylinder head, loosen and remove the rocker arm studs. Store them separately in marked containers to ensure that they will be reinstalled in their original locations. **Note 1:** If the pushrods are the only items being removed, loosen each nut (models through 1998) just enough to allow the pushrods can be lifted out. to the side so the pushrods can be lifted out.
- Note 2:** On 2000 and later models, the roller-rocker arms are retained by a bolt, there are no pivot balls. Unlike the late four-cylinder models with roller rockers, the V6 rockers ride on long rocker arm supports that bolt against the cylinder head casting protrusions.
- 3 Lift off the rocker arms and pivot balls and store them in the marked containers with the nuts (they must be reinstalled in their original locations).
- 4 Remove the pushrods and store them separately to make sure they don't get mixed up during installation (see illustration).

Inspection

- 5 Check each rocker arm for wear, cracks and other damage, especially where the pushrods and valve stems contact the rocker arm faces.
- 6 Make sure the hole at the pushrod end of each rocker arm is open.
- 7 Check each rocker arm pivot area for wear, cracks and galling. If the rocker arms are worn or damaged, replace them with new



- 4.11 Moly-base grease applied to the pivot balls will ensure adequate lubrication until oil pressure builds up when the engine is started

ones and use new pivot balls as well. On 2000 and later models, align the roller rocker arms with the rocker arm supports.

8 Inspect the pushrods for cracks and excessive wear at the ends. Roll each pushrod across a piece of plate glass to see if it's bent (if it wobbles, it's bent).

Installation

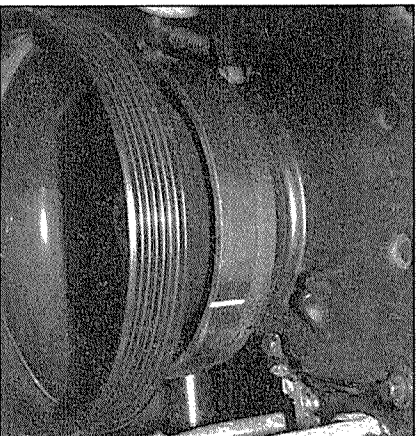
Refer to illustrations 4.10 and 4.11

- 9 Lubricate the lower end of each pushrod with clean engine oil or moly-base grease and install them in their original locations. Make sure each pushrod seats completely in the lifter.
- 10 Apply moly-base grease to the ends of the valve stems and the upper ends of the pushrods before positioning the rocker arms over the studs (see illustration).
- 11 Set the rocker arms in place, then install the pivot balls and nuts. Apply moly-base grease to the pivot balls to prevent damage to the mating surfaces before engine oil pressure builds up (see illustration). Be sure to install each nut with the flat side against the pivot ball. Tighten the rocker-arm nuts to the torque listed in this Chapter's Specifications.
- 12 The remainder of the installation is the reverse of removal.
- 13 Start the engine and check for valve cover leaks and valvetrain noise.

Valve adjustment (1994 VIN Z engines only)

Refer to illustrations 4.14 and 4.17

Note: On most models covered by this book, there are no provisions for valve adjustment. The rocker arm studs have a positive stop shoulder for the rocker arm nuts. After valve service, tighten the rocker arm nuts to the torque listed in this Chapter's Specifications. Unless there have been machining operations that significantly altered the valve lash, the adjustment should be correct. Some 1994 VIN Z engines have press-in rocker-arm studs, without a positive stop, and require the following valve adjustment procedure when-



4.14 Align the timing marks on the damper and front cover to find TDC

ever the rocker arms have been loosened or removed.

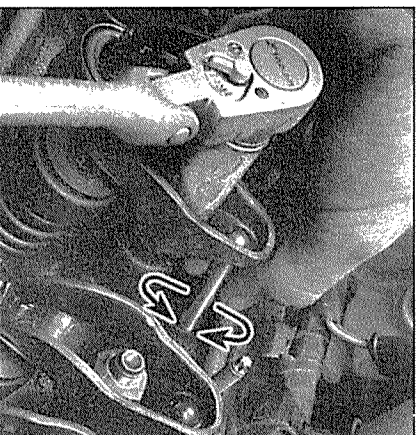
14 Begin by setting the engine to TDC for piston number 1. Top Dead Center (TDC) is the highest point in the cylinder that each piston reaches as it travels up-and-down when the crankshaft turns. Each piston reaches TDC on the compression stroke and again on the exhaust stroke, but TDC generally refers to piston position on the compression stroke. The timing marks on the vibration damper installed on the front of the crankshaft are referenced to TDC (see illustration) and will line up at TDC for number 1 or number 4.

15 In order to bring any piston to TDC, the crankshaft must be turned using a large socket and breaker bar attached to the bolt threaded into the crankshaft damper. When looking at the front of the engine, normal crankshaft rotation is clockwise. **Warning:** Before beginning this procedure, be sure to place the transmission in Neutral and unplug the electrical connector(s) at the distributor to disable the ignition system.

16 Turn the engine until the mark on the damper aligns with the "0" mark on the timing tab while observing the rocker arms for the number 1 cylinder. If the valves were moving as the marks began to align, then this is TDC for number 4, and the engine must be turned one more revolution.

17 At TDC for number 1 piston, the following rocker arms can be adjusted: number 1, 5, and 6 exhaust valves, and number 1, 2 and 3 intake valves. To adjust the valves, tighten the rocker arm nut 3/4 turn past zero lash. To find zero lash, rotate the pushrod (or the valve being adjusted) between two fingers while tightening the rocker-arm nut (see illustration). When a slight drag on the pushrod is just felt, all lash is removed, tighten the rocker-arm nut an additional 3/4 turn to center the hydraulic lifter plunger in its travel.

18 After the number one piston has been positioned at TDC on the compression stroke, TDC for any of the remaining cylinders can be located by turning the crankshaft 120-degrees at a time and following the firing order (see the Specifications at



4.17 Rotate each pushrod as the rocker-arm nut is tightened until a slight drag is felt (zero lash), then tighten an additional 3/4 turn

the beginning of this Chapter).

19 Rotate the crankshaft 360-degrees (TDC number 4) and adjust the following rocker arms: number 2, 3 and 4 exhaust valves, and number 4, 5 and 6 intake valves.

5 Valve springs, retainers and seals - replacement

Refer to illustrations 5.4, 5.7a, 5.7b, 5.8, 5.15 and 5.16

Note: Broken valve springs and defective valve stem seals can be replaced without removing the cylinder heads. Two special tools and a compressed air source are normally required to perform this operation, so read through this Section carefully and rent or buy the tools before beginning the job.

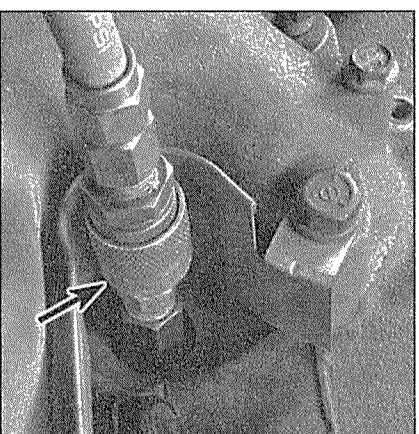
1 Remove the valve cover from the cylinder head (see Section 3). If all of the valve stem seals are being replaced, remove both valve covers.

2 Remove the spark plug from the cylinder which has the defective component. If all of the valve stem seals are being replaced, all of the spark plugs should be removed.

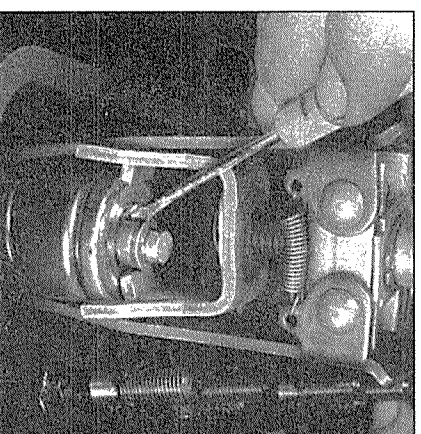
3 Turn the crankshaft until the piston on the affected cylinder is at top dead center on the compression stroke (see Section 4). If you are replacing all of the valve stem seals, begin with cylinder number 1 and work on the valves for one cylinder at a time. Move from cylinder-to-cylinder following the firing order sequence (1-6-5-4-3-2). Each cylinder in the firing order is 120-degrees of crankshaft rotation (clockwise) from the previous one.

4 Thread an adapter into the spark plug hole (see illustration) and connect an air hose from a compressed air source to it. Most auto parts stores can supply the air hose adapter. **Note:** Many cylinder compression gauges utilize a screw-in fitting that may work with your air hose quick-disconnect fitting.

5 Remove the nut, pivot ball and rocker arm for the valve with the defective part and pull out the pushrod (see Section 4). If all the valve



5.4 Use compressed air to hold the valve closed when the springs are removed - the air hose adapter (arrow) threads into the spark plug hole and accepts the hose from the compressor

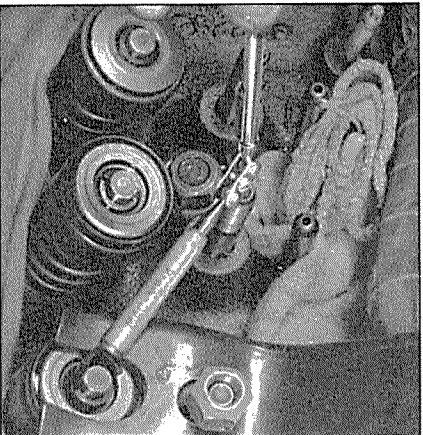


5.7a Once the spring is depressed, the keepers can be removed with a small magnet or needle-nose pliers (a magnet is preferred to prevent dropping the keepers

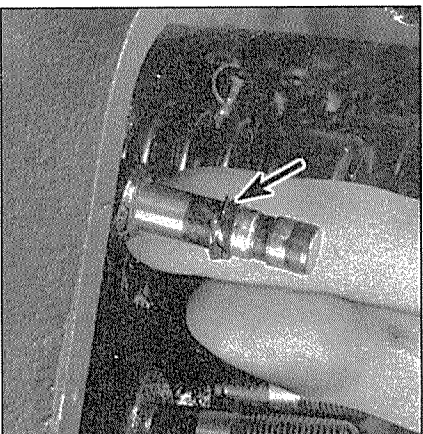
stem seals are being replaced, all of the rocker arms and pushrods should be removed.

6 Apply compressed air to the cylinder. The valves should be held in place by the air pressure. **Warning:** If the cylinder isn't exactly at TDC, air pressure may cause the engine to rotate. Do not leave a socket or wrench on the balancer bolt; damage or personal injury may result.

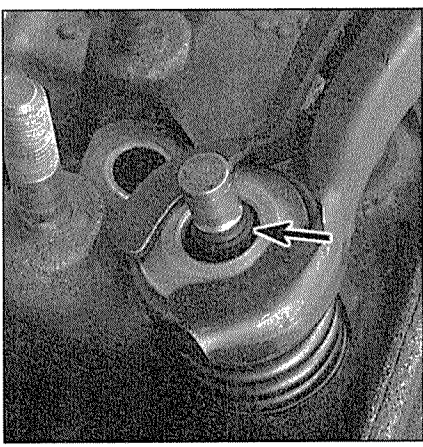
7 Stuff shop rags into the cylinder head holes above and below the valves to prevent parts and tools from falling into the engine, then use a valve spring compressor to compress the spring/damper assembly. Remove the keepers with small needle-nose pliers or a magnet (see illustration). **Note:** A couple of different types of tools are available for compressing the valve springs with the cylinder head in place. One type, shown here, grips the lower spring coils and presses on the retainer as the knob is turned, while the other type utilizes the rocker arm stud and nut for leverage (see illustration). Both types work very well, although the lever type is usually less expensive.



5.7b The stamped steel lever-type valve spring compressor is usually less expensive than the type that grips the spring coils



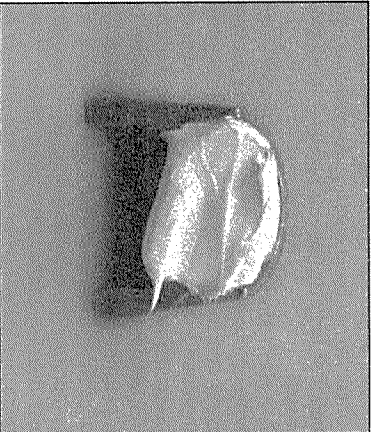
5.8 The O-ring seal (arrow) should be replaced with a new one each time the keepers and retainer are removed



5.15 Make sure the O-ring seal under the retainer is seated in the groove and not twisted before installing the keepers

cylinder head will have to be removed for repair.

- 8 Remove the spring retainer, oil shield and valve spring assembly (there is both an inner and outer valve spring for each valve - the inner is called a spring damper), then remove the valve stem O-ring seal and the umbrella-type guide seal (intake valves only). The O-ring seal will most likely be hardened and will probably break when removed, so plan on installing a new one each time the original is removed (see illustration). **Note:** If air pressure fails to hold the valve in the closed position during this operation, the valve face and/or seat is probably damaged. If so, the cylinder head will have to be removed for additional repair operations.
- 9 Wrap a rubber band or tape around the top of the valve stem so the valve won't fall into the combustion chamber, then release the air pressure.
- 10 Inspect the valve stem for damage. Rotate the valve in the guide and check the end for eccentric movement, which would indicate that the valve is bent.
- 11 Move the valve up-and-down in the guide and make sure it does not bind. If the valve stem binds, either the valve is bent or the guide is damaged. In either case, the



5.16 Apply a small dab of grease to each keeper as shown here before installation - it will hold them in place on the valve stem as the spring is released

- 12 Reapply air pressure to the cylinder to retain the valve in the closed position, then remove the tape or rubber band from the valve stem.
- 13 Lubricate the valve stem with engine oil and install a new umbrella-type guide seal (intake valve only). On 1999 and later models, there are seals on all valve guides. Replacement seals for the exhaust are colored red or brown, while intake seals are black.
- 14 Install the spring/damper assembly and shield in position over the valve.
- 15 Install the valve spring retainer or rotor. Compress the valve spring assembly and carefully install the new O-ring seal in the lower groove of the valve stem. Make sure the seal isn't twisted - it must lie perfectly flat in the groove (see illustration).

- 16 Position the keepers in the upper groove. Apply a small dab of grease to the inside of each keeper to hold it in place if necessary (see illustration). Remove the pressure from the spring tool and make sure the keepers are seated.
- 17 Disconnect the air hose and remove the adapter from the spark plug hole
- 18 Install the rocker arm(s) and pushrod(s) (see Section 4).
- 19 Install the valve cover(s) (see Section 3).
- 20 Install the spark plug(s) and hook up the wire(s).
- 21 Start and run the engine, then check for oil leaks and unusual sounds coming from the valve cover area.

6 Intake manifold - removal and installation

Removal

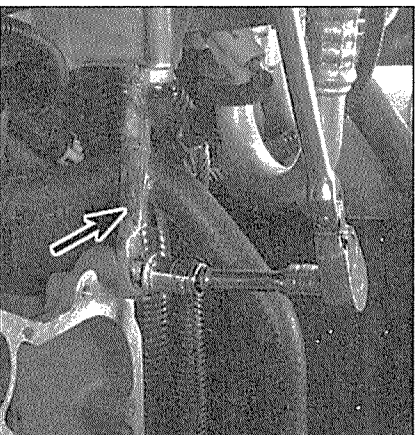
- 1 Disconnect the negative cable from the battery. **Caution:** On models equipped with a Delco Loc II audio system, be sure the lock-out feature is turned off before performing any procedure which requires disconnecting the battery.

1994 and 1995 VIN Z models

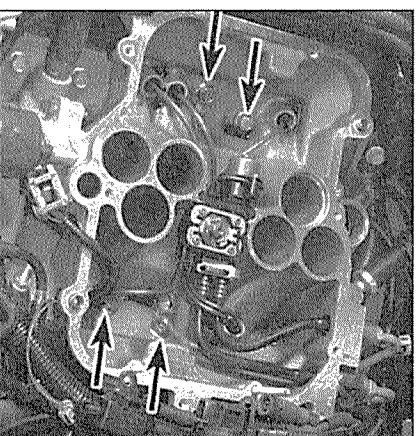
- 2 Remove the upper fan shroud.
- 3 Remove the air cleaner assembly (see Chapter 4).
- 4 Drain the cooling system (see Chapter 1).
- 5 Disconnect the upper radiator and heater hoses at the front of the engine.
- 6 Remove the two rear braces from the drivebelt tensioner.
- 7 Unbolt and move the emission relays bracket.
- 8 Remove the spark plug wires, coil and distributor (see Chapters 1 and 5). **Note:** The engine should be turned to TDC (see Section 4) for the number 1 piston. Mark the relationship of the distributor rotor to the distributor housing before removing the distributor.
- 9 Disconnect the fuel lines at the TBI unit (see Chapter 4). **Warning:** The fuel system is under pressure - do not disconnect the lines without following the safety procedures in Chapter 4.
- 10 Remove the accelerator, cruise control and TV cables from the bracket(s) on the manifold (see Chapter 4).
- 11 Detach the vacuum brake booster pipe from the manifold.
- 12 Label and disconnect the fuel lines, vacuum hoses/pipes and wires at the manifold and TBI unit (see Chapter 4).
- 13 Disconnect and move the EGR hose.
- 14 Loosen the manifold mounting bolts in 1/4-turn increments until they can be removed by hand. **Note:** Some of the manifold fasteners are studs and will require a deep socket to remove. The manifold will probably be stuck to the cylinder heads and force may be required to break the gasket seal. A large prybar can be positioned under the cast-in lug near the left front mounting bolt to pry up the front of the manifold, but make sure all bolts have been removed first! **Caution:** Don't pry between the block and manifold or the cylinder heads and manifold or damage to the gasket sealing surfaces may occur, leading to vacuum leaks.



6.15 Disconnect the upper radiator hose (lower arrow) and heater hose (upper arrow) from the intake manifold



6.19 Remove this short brace (arrow) from the air conditioning compressor to the intake manifold



6.21a There are four bolts inside the manifold (arrows) plus four bolts ahead of the plenum and four behind the plenum

1994 and 1995 VIN W and all 1996 and later models

Refer to illustrations 6.15, 6.19, 6.21a and 6.21b

15 Complete Steps 2 through 5 above (see illustration).

16 Refer to Chapter 4 for removal of the upper intake plenum, linkage, wiring and disconnection of the fuel lines and injector harnesses. **Warning:** The fuel system is under pressure. Do not disconnect the lines without following the safety procedures in Chapter 4.

17 Unbolt the EGR valve from the lower manifold and move it out of the way (see Chapter 6).

18 Move the heater hoses from the bracket above the right valve cover. Remove the ignition coil (see illustration 3.5).

19 Remove the small brace from the air conditioning compressor to the intake manifold (see illustration).

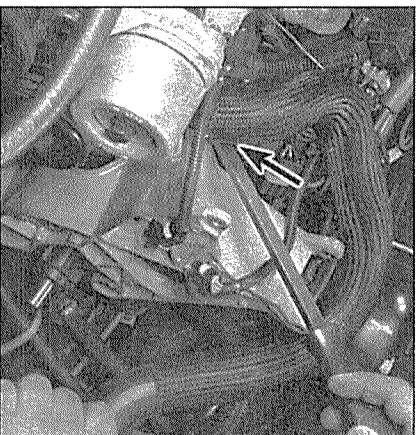
20 Turn the engine to TDC for number 1 piston (see Section 4) and remove the distributor. **Note:** Mark the relationship of the distributor rotor to the distributor housing before removing the distributor.

21 The manifold will probably be stuck to the cylinder heads and force may be required to break the gasket seal. A large prybar can be positioned under the cast-in lug near the left front mounting bolt to pry up the front of the manifold, but make sure all bolts have been removed first (see illustrations)! **Caution:** Don't pry between the block and manifold or the cylinder heads and manifold or damage to the gasket sealing surfaces may occur, leading to vacuum leaks.

Installation (all models)

Refer to illustrations 6.22, 6.23, 6.24, 6.25, 6.27, 6.29a and 6.29b

Warning: Composition gaskets, with a metal core and compressible material on each side, are used in the intake systems of these engines. Be careful in handling the edges of these gaskets; sharp metal edges may be exposed.

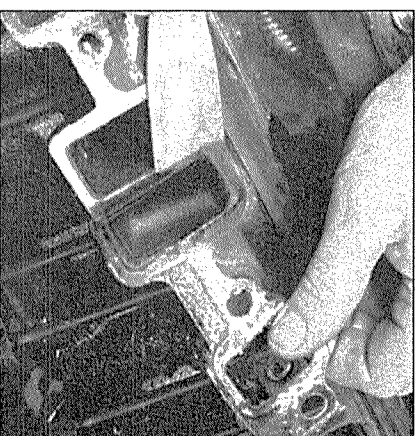


6.21b Pry only under the casting lug near the left front mounting bolt (arrow)

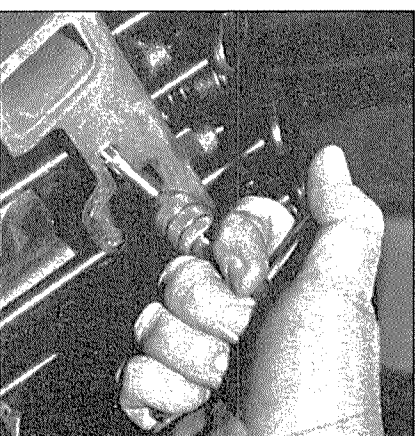
Note: The mating surfaces of the cylinder heads, block and manifold must be perfectly clean when the manifold is installed. Gasket removal solvents in aerosol cans are available at most auto parts stores and may be helpful when removing old gasket material that's stuck to the cylinder heads and manifold (since the manifold is made of aluminum, aggressive scraping can cause damage). Be sure to follow the directions printed on the container.

22 Use a plastic or wooden gasket scraper to remove all traces of sealant and old gasket material, then clean the mating surfaces with lacquer thinner or acetone. Do not use abrasive pads or discs to clean the gasket surfaces. If there's old sealant or oil on the mating surfaces when the manifold is installed, oil or vacuum leaks may develop. When working on the cylinder heads and block, cover the lifter valley with shop rags to keep debris out of the engine (see illustration). Use a vacuum cleaner to remove any gasket material that falls into the intake ports in the cylinder heads.

23 Use a tap of the correct size to chase the threads in the bolt holes, then use compressed air (if available) to remove the debris from the holes (see illustration). **Warning:** Wear safety glasses or a face shield to pro-

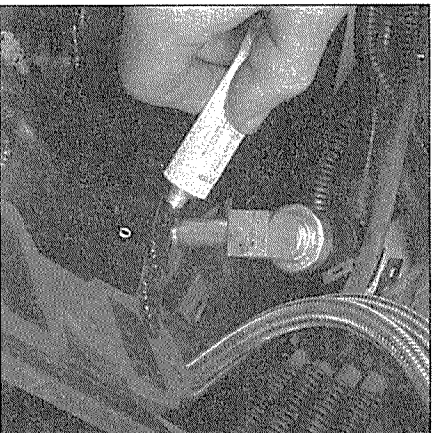


6.22 After covering the lifter valley, use a gasket scraper to remove all traces of sealant and old gasket material from the cylinder head and manifold mating surfaces

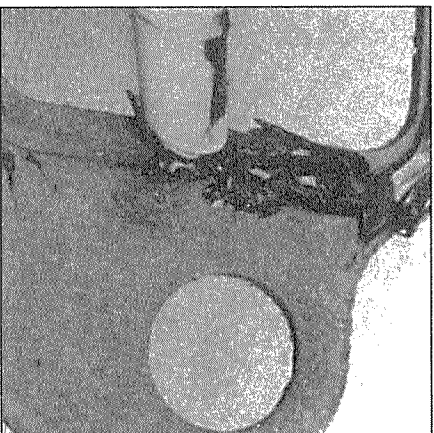


6.23 The bolt hole threads must be clean and dry to ensure accurate torque readings when the manifold mounting bolts are installed

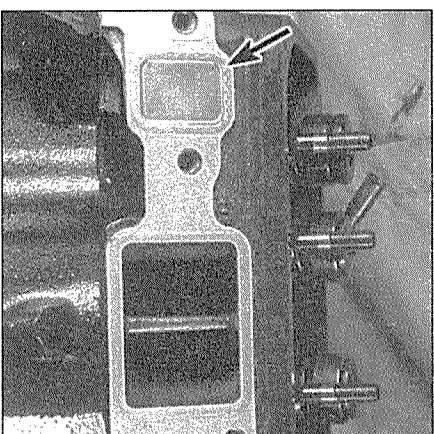
tect your eyes when using compressed air! Remove excessive carbon deposits and corrosion from the exhaust, EGR and coolant passages in the cylinder heads and manifold.



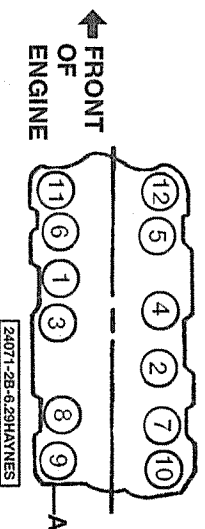
6.24 Intake manifold sealant application details



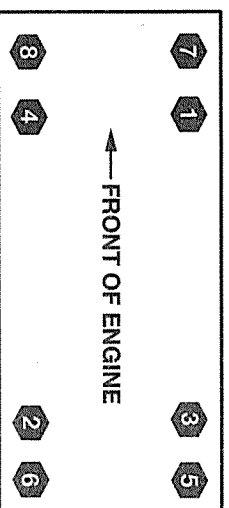
6.25 RTV sealant should be used around the coolant passage holes in the new intake manifold gaskets



6.27 Make sure the gaskets are installed with the blocked off holes (arrow) to the rear



6.29a Intake manifold bolt tightening sequence (1994 and 1995 models) - on VIN Z models, bolt A must be tightened an additional amount (see this Chapter's Specifications)



6.29b Intake manifold bolt tightening sequence (1996 and later models)

24 Apply a 3/16-inch wide bead of RTV sealant to the front and rear manifold mating surfaces of the block (see illustration). Make sure the beads extend up the cylinder heads 1/2-inch on each side.

25 Apply a thin coat of RTV sealant around the coolant passage holes on the cylinder head side of the new intake manifold gaskets (see illustration).

26 Position the gaskets on the cylinder heads, with the ears at each end overlapping the bead of RTV sealant on the cylinder head. The upper side of each gasket will have a THIS SIDE UP label stamped into it to ensure correct installation.

27 Make sure all intake port openings, coolant passage holes and bolt holes are aligned correctly. **Note:** Be sure the gaskets are installed with the blocked off coolant passages at the rear of the engine (see illustration). Some gaskets may have small tabs which must be bent over until they're flush with the rear surface of each cylinder head.

28 Carefully set the manifold in place while the sealant is still wet. **Caution:** Don't disturb the gaskets and don't move the manifold fore-and-aft after it contacts the sealant on the block.

29 Following the recommended sequence, install the bolts and tighten them to the torque listed in this Chapter's Specifications (see illustrations). Work up to the final

torque in two stages and note that there are different sequences for different models.

30 The remaining installation steps are the reverse of removal. Start the engine and check carefully for oil and coolant leaks at the intake manifold joints.

7 Exhaust manifolds - removal and installation

Removal

Refer to illustrations 7.4, 7.10, 7.13, 7.14a and 7.14b

Warning: Use caution when working around the exhaust manifolds, the sheetmetal heat shields can be sharp on the edges. Also, the engine should be cold when this procedure is followed.

1 Disconnect the negative battery cable from the battery. **Caution:** On models equipped with a Delco Loc II audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery.

2 Raise the vehicle and support it securely on jackstands.

3 Working under the vehicle, apply penetrating oil to the exhaust pipe-to-manifold studs and nuts (they're usually rusty).

4 Remove the nuts retaining the exhaust

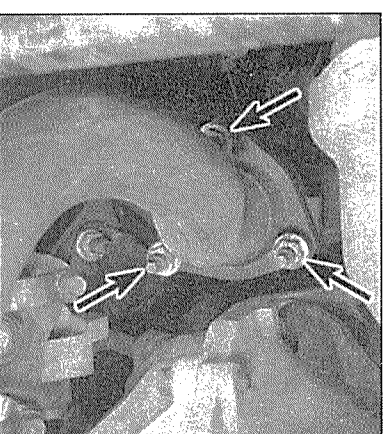
pipe(s) to the manifold(s) (see illustration). **Note:** On some later models, you may have to remove the tie for access to the exhaust nuts through the fenderwell opening.

Right side manifold

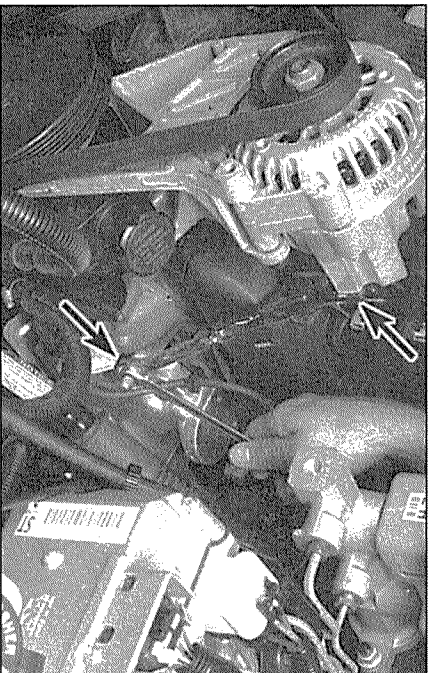
5 On early models, remove the air cleaner assembly (see Chapter 4).

6 Remove the heat stove pipe on TBI models.

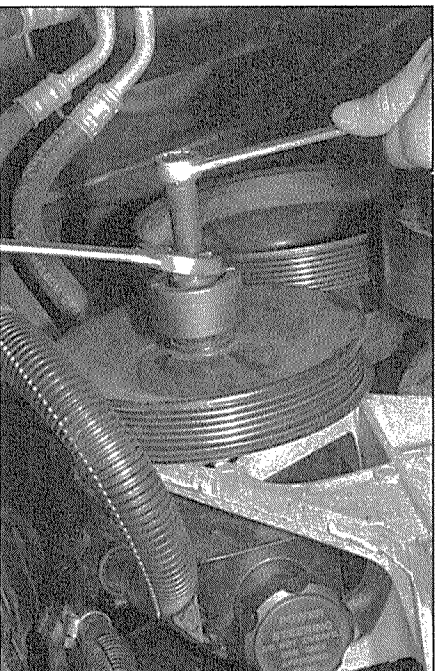
7 Detach the spark plug wires from the



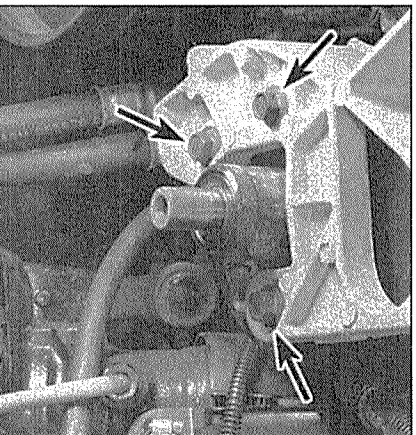
7.4 Access the exhaust pipe bolts/nuts from underneath the vehicle - on some models it may be easier to remove the wheel and work through the fenderwell opening



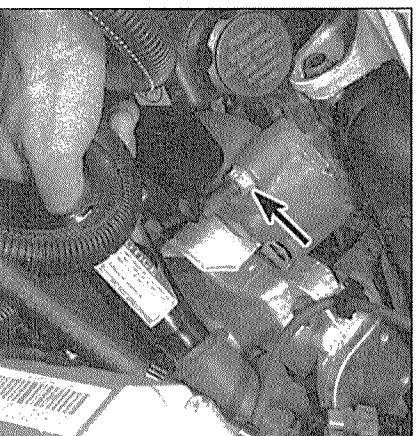
7.10 Remove the bolt and nut (arrows) retaining the alternator brace to the exhaust manifold stud



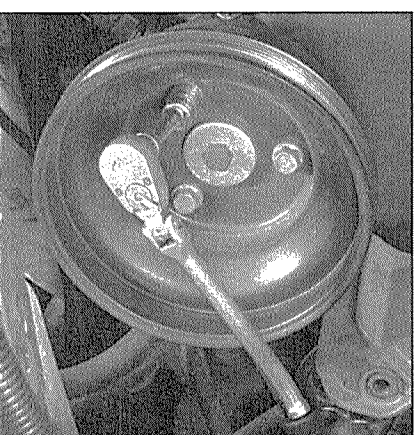
7.13 Use a puller like this to remove the power steering pump pulley



7.14a Remove the three power steering pump mounting bolts (arrows)



7.14b Slide the power steering pump over, with rear bracket attached, until the bracket clears the exhaust stud (arrow)



8.3 Remove the three bolts retaining the pulley to the damper, then remove the center crankshaft bolt

plugs and brackets and position them out of the way (see Chapter 1).

8 Unbolt the air conditioning compressor and its bracket and set it aside (see Chapter 3). **DO NOT** disconnect the hoses from the compressor. **Warning:** The air conditioning system is under high pressure. **DO NOT** disassemble any part of the system unless the system has been depressurized.

9 Remove the oil dipstick, unbolt the dipstick tube bracket and move the dipstick tube.

Left side manifold

10 On 1994 and 1995 models, unbolt and remove the rear brace from the alternator (see illustration).

11 Detach the spark plug wires from the plugs and brackets and position them out of the way.

12 On 1996 and later models, disconnect the EGR pipe from the exhaust manifold.

13 The rear power steering bracket must be removed from the exhaust manifold stud, but to do so the power steering pump must be removed. Use a puller to remove the pulley from the pump (see illustration).

14 With the pulley off, remove the three pump mounting bolts (see illustration). Do not disconnect the power steering lines.

Remove the nut from the exhaust manifold stud, slide the bracket off the stud and set the pump aside (see illustration).

Both manifolds

15 Bend the lock tabs back, then remove the mounting bolts and separate the exhaust manifold from the cylinder head. Remove the heat shields from the left side manifold after the bolts are removed. **Note:** 1994 and 1995 models use washers and locking tabs under all bolts; later models do not. Also, make note of the location of studs used on the left manifold on all models.

Installation

16 Check the manifold for cracks and make sure the bolt threads are clean and undamaged. The manifold and cylinder head mating surfaces must be clean before the manifolds are reinstalled - use a gasket scraper to remove all carbon deposits.

17 Position the manifold, locking tabs and heat shields (if equipped) on the cylinder head and install the mounting bolts.

18 When tightening the mounting bolts, work from the center to the ends and be sure to use a torque wrench. Tighten the bolts in three equal steps to the torque listed in this

Chapter's Specifications. On 1994 and 1995 models, bend the locking tabs back against the bolt heads.

19 The remaining installation steps are the reverse of removal.

20 Start the engine and check for exhaust leaks.

8 Crankshaft front oil seal - replacement

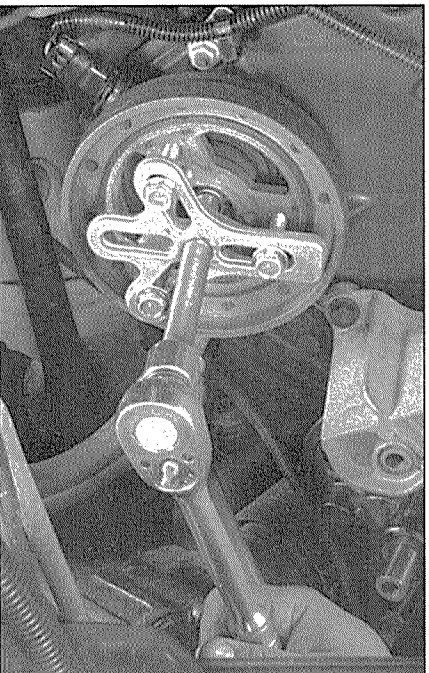
Front seal - timing chain cover in place

Refer to illustrations 8.3, 8.4, 8.5 and 8.7

1 Disconnect the negative battery cable from the battery. **Caution:** On models equipped with a Delco Loc II audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery.

2 Remove the upper and lower fan shrouds, the cooling fan (see Chapter 3) and the drivebelt (see Chapter 1).

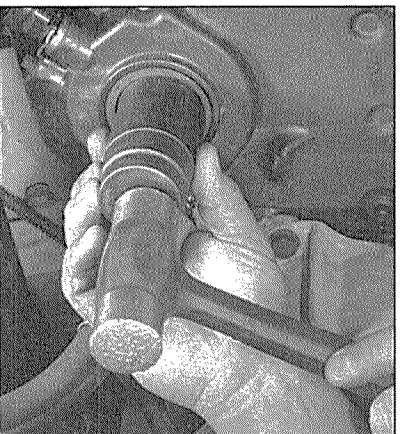
3 Remove the bolts and separate the crankshaft drivebelt pulley from the vibration damper (see illustration).



8.4 Use the recommended puller to remove the damper or damage to the damper may result



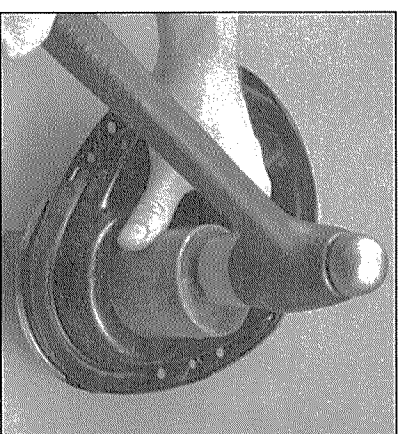
8.5 Using a seal removal tool or a screwdriver, pry the front seal out of the cover - don't distort the cover or scratch the crankshaft



8.7 The new, lubricated seal can be driven in with a large socket or section of pipe - drive it in squarely, to the depth of the original seal



8.9 While supporting the cover near the seal bore, drive the old seal out from the inside with a hammer and punch



8.11 Clean the bore, then apply a small amount of oil to the outer edge of the seal and drive it squarely into the opening with a large socket and hammer - do not damage the seal in the process

4 Remove the lower flywheel cover (see Chapter 7) and have an assistant wedge a large screwdriver in the flywheel ring gear teeth to hold the engine from turning while you remove the bolt from the front of the crankshaft with a socket and breaker bar. Then use a puller to detach the vibration damper (see illustration). **Caution:** Don't use a puller with jaws that grip the outer edge of the damper. The puller must be the type shown in the illustration that applies force to the damper hub only. Unless your puller has a tip with a short taper where it meets the crankshaft, insert a short bolt that fits the crankshaft threads, then use the puller against the bolt rather than the crankshaft, to avoid damage to the crankshaft.

5 Carefully pry the seal out of the cover with a seal removal tool or a large screwdriver (see illustration). Be careful not to distort the cover or scratch the wall of the seal bore. If the engine has accumulated a lot of miles, apply penetrating oil to the seal-to-cover joint and allow it to soak in before attempting to pull the seal out.

6 Clean the bore to remove any old seal material and corrosion. Position the new seal in the bore with the open end of the seal fac-

ing in. A small amount of grease applied to the outer edge of the new seal will make installation easier.

7 Apply a light film of grease to the lip of the seal. Drive the seal into the bore with GM tool no. J-23042A, or equivalent, until it's completely seated. If the special tool isn't available, a socket that's the same outside diameter as the seal or a section of pipe can be used (see illustration).

8 Reinstall the vibration damper, aligning its groove with the keyway in the crankshaft. **Caution:** Use the bolt to pull the damper on - do not use a hammer or the rubber-mounted inertia-weight section of the damper may be damaged.

Front seal - timing chain cover removed

Refer to illustrations 8.9 and 8.11

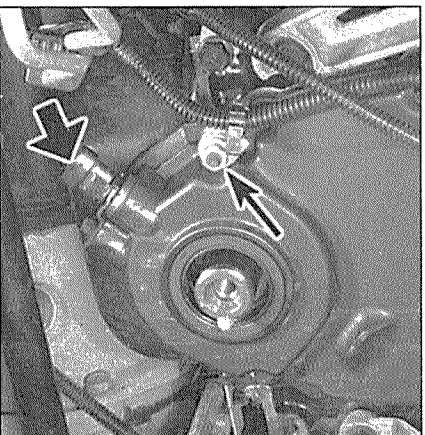
Note: 1995 VIN W engines and all 1996 and later engines use a composite-material front cover, which is not reusable. It is recommended to replace it rather than try to resseat it and have it leak later. The following procedure is for 1995 and earlier models with steel front covers.

9 Use a punch or screwdriver and hammer to drive the seal out of the cover from the back side. Support the cover as close to the seal bore as possible (see illustration). Be careful not to distort the cover or scratch the wall of the seal bore. If the engine has accumulated a lot of miles, apply penetrating oil to the seal-to-cover joint on each side and allow it to soak in before attempting to drive the seal out.

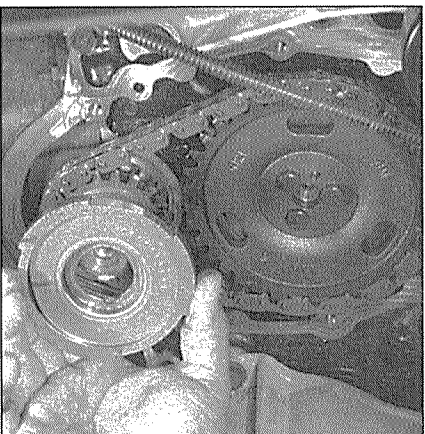
10 Clean the bore to remove any old seal material and corrosion. Support the cover on blocks of wood and position the new seal in the bore with the open end of the seal facing in. A small amount of grease applied to the outer edge of the new seal will make installation easier.

11 Drive the seal into the bore with a large socket and hammer until it's completely seated (see illustration). Select a socket that's the same outside diameter as the seal (a section of pipe can be used if a socket isn't available). Install the timing chain cover.

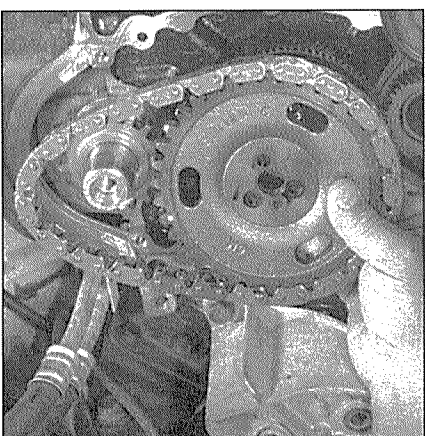
12 Reinstall the cover (see Section 9). The remainder of the installation is the reverse of the disassembly. Start the engine and check for leaks.



9.4 Remove the crankshaft position sensor (large arrow) and remove the nut (upper arrow) retaining the wiring harness to the cover stud



9.6 Before removing the sprockets or chain, remove the reluctor ring from the crankshaft - note the dished side faces the timing chain cover



9.7 Remove the three bolts from the end of the camshaft and remove the camshaft sprocket and chain as an assembly

9 Timing chain cover, chain and sprockets - removal and installation

Removal

Refer to illustrations 9.4, 9.6 and 9.7

- 1 Disconnect the negative battery cable. **Caution:** On models equipped with a Delco Loc II audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery.
- 2 Refer to Chapter 3 and remove the upper and lower fan shrouds, drivebelt, cooling fan and water pump.

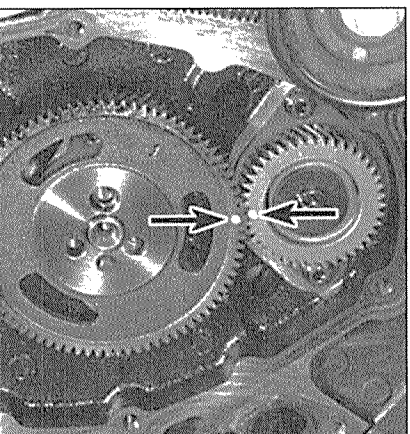
- 3 Position the number four piston at TDC on the compression stroke (see Section 4). **Caution:** Once this has been done, DO NOT turn the crankshaft until the timing chain and sprockets have been reinstalled!

- 4 Refer to Section 8 and remove the drive-belt pulley and the crankshaft damper. **Note:** On some 1995 models, and all 1996 models, remove the crankshaft position sensor and the nut retaining the wiring harness to the front cover (see illustration).

- 5 Loosen the front oil pan nuts, then remove the cover bolts and separate the timing chain cover from the block. It may be stuck - if so, use a putty knife or screwdriver to break the gasket seal. The cover is easily distorted, so be very careful when prying it off - because the bottom of the cover has studs going through the pan, and because there are two dowels pins into the block that are part of the cover, the cover must be pulled forward to clear the dowels, then up to clear the studs. **Note:** 1995 VIN W engines and all 1996 and later engines use a composite-material front cover, which is not reusable. It is recommended to replace it rather than try to resal it and have it leak later.

- 6 Remove the crankshaft position sensor reluctor ring just inside the front cover (see illustration).

- 7 Remove the three bolts from the end of the camshaft, then detach the camshaft



9.11 Before installing the camshaft sprocket, make sure the timing marks on the balance shaft gears are properly aligned (arrows)

sprocket and chain as an assembly (see illustration). **Note:** The balance shaft drive gear will stay attached to the camshaft and the driven gear will stay attached to the balance shaft. The sprocket on the crankshaft can be removed with a two- or three-jaw puller, but be careful not to damage the threads in the end of the crankshaft. If the timing chain cover oil seal has been leaking, refer to Section 8 and install a new one.

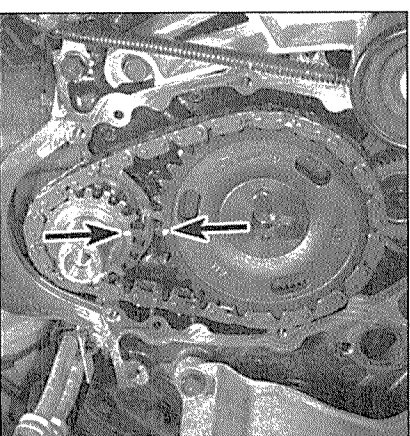
Installation

Refer to illustrations 9.11 and 9.12

- 8 Use a gasket scraper to remove all traces of old gasket material and sealant from the cover and engine block. Stuff a shop rag into the opening at the front of the oil pan to keep debris out of the engine. Clean the cover and block sealing surfaces with lacquer thinner or acetone.

- 9 Check the cover flange for distortion, particularly around the bolt holes. If necessary, place the cover on a block of wood and use a hammer to flatten and restore the gasket surface.

- 10 If new parts are being installed, be sure

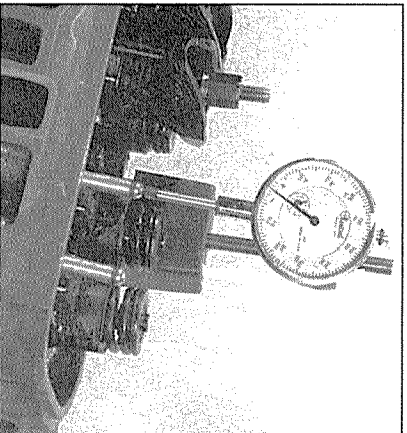


9.12 Position the timing marks on the camshaft and crankshaft sprockets in the 6 and 12 o'clock positions, respectively. A straight line should pass through the camshaft timing mark, the center of the camshaft, the crankshaft timing mark and the center of the crankshaft - when aligned as shown the number four piston is at TDC on the compression stroke

to align the keyway in the crankshaft sprocket with the Woodruff key in the end of the crankshaft. Press the sprocket onto the crankshaft with the vibration damper bolt, a large socket and some washers; or tap it gently into place until it's completely seated. **Caution:** If resistance is encountered, DO NOT hammer the sprocket onto the crankshaft. It may eventually move onto the shaft, but it may be cracked in the process and fail later, causing extensive engine damage.

- 11 Before installing the timing chain and camshaft sprocket, align the balance shaft gears (see illustration). The camshaft should be positioned with the balance shaft drive gear timing mark at 12 o'clock and the driven gear mark at 6 o'clock.

- 12 Position the crankshaft so the sprocket timing mark is in the 12 o'clock position. Loop the chain over the camshaft sprocket, mesh the chain with the crankshaft sprocket and position the camshaft sprocket on the



10.2 When checking the camshaft lobe lift, the dial indicator plunger must be positioned directly above the pushrod

camshaft with the timing mark in the 6 o'clock position. When correctly installed, the marks on the sprockets will be aligned as shown (**see illustration**). **Note:** The number four piston will be at TDC on the compression stroke with the sprockets aligned as shown.

13 Apply Loctite to the camshaft sprocket bolt threads, then install and tighten them to the torque listed in this Chapter's Specifications. Lubricate the chain with clean engine oil.

14 Check the oil pan-to-block joints to make sure that all excess sealant is removed.

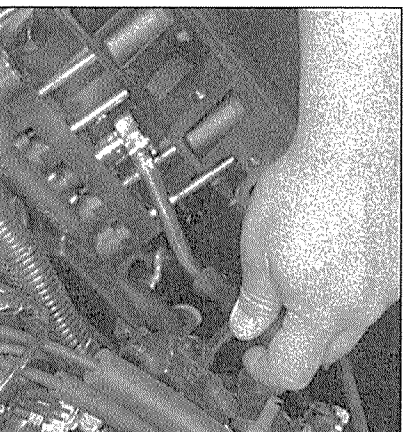
15 Apply RTV sealant to the U-shaped channel on the bottom of the cover.

16 Apply a thin layer of RTV sealant to both sides of the new gasket, then position it on the engine block (the dowel pins and sealant will hold it in place). **Note:** The composite covers do not have a gasket, they use sealant only. Resealing the old cover is not recommended, but rather replace it to avoid sealing problems caused by the distortion of prying the old cover off.

17 Since the oil pan seal in the bottom of the cover must be compressed in order to position the cover over the dowel pins and thread the bolts into the block, the cover is nearly impossible to install unless the oil pan is removed first. It can be done, but it's very difficult and frustrating. If the front three bolts on each side of the oil pan are removed, the oil pan can be pried down slightly, allowing the cover to be installed. Squirt some RTV sealant into the gap between the pan and the block. If difficulty is encountered, it may be necessary to remove the oil pan (**see Section 12**).

18 Install the timing chain cover and tighten the bolts to the torque listed in this Chapter's Specifications. If the front of the oil pan was pried down, install the bolts and tighten them to the torque listed in this Chapter's Specifications.

19 Lubricate the oil seal contact surface of the vibration damper hub with moly-base grease or clean engine oil, then install the damper on the end of the crankshaft. The keyway in the damper must align with the Woodruff key in the crankshaft nose. If the damper cannot be seated by hand, slip a large washer over the bolt, install the bolt and tighten



10.7 The roller lifters are held in place by a retainer - remove the four retainer bolts and remove the retainer

it to force the damper into place. Remove the large washer and tighten the bolt to the torque listed in this Chapter's Specifications.

20 The remaining installation steps are the reverse of removal. Use a new O-ring when reinstalling the crankshaft position sensor.

10 Camshaft and lifters - removal, inspection and installation

Camshaft lobe lift check

Refer to illustration 10.2

1 In order to determine the extent of cam lobe wear, the lobe lift should be checked prior to camshaft removal. Remove the valve covers (**see Section 3**). Refer to Section 4 and loosen the rocker arm nuts, then pivot the rocker arms to the side for access to the pushrods.

2 Mount a dial indicator on the engine and position the plunger against the top of the first pushrod. The plunger should be directly in line with the pushrod (**see illustration**). **Note:** Disconnect the electrical connectors from the distributor to disable the ignition before making this test.

3 Turn the engine slowly until the pushrod is at its lowest point; this is the base circle of the camshaft lobe. Zero the dial indicator, then very slowly turn the crankshaft in the normal direction of rotation until the indicator needle reaches its peak and begins to move in the opposite direction. The point at which it stops indicates maximum cam lobe lift.

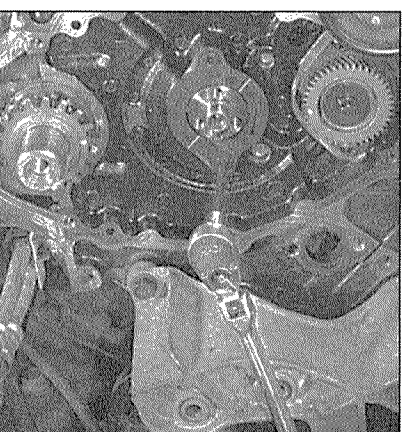
4 Record this figure for future reference, then repeat the check for the remaining lobes. Be sure to record the results for each lobe.

5 After the check is complete, compare the results to this Chapter's Specifications. If camshaft lobe lift is 0.003 inch less than specified, cam lobe wear has occurred and a new camshaft should be installed.

Removal

Refer to illustrations 10.7, 10.9 and 10.10

6 Refer to the appropriate Sections and remove the intake manifold, the rocker arms, the pushrods and the timing chain and



10.9 Remove the Torx bolts and take off the camshaft retainer plate, noting which side faces the block

camshaft sprocket. The fan shrouds, fan, radiator and condenser should be removed as well (**see Chapter 3**).

7 Before removing the lifters, arrange to store them in a clearly labeled box to ensure that they're reinstalled in their original locations. Remove the lifter retainer (**see illustration**). Remove the lifters and store them where they won't get dirty. DO NOT attempt to withdraw the camshaft with the lifters in place.

8 There are several ways to extract the lifters from the bores. A special tool designed to grip and remove lifters is manufactured by many tool companies and is widely available, but it may not be required in every case. On newer engines, without a lot of varnish buildup, the lifters can often be removed with a small magnet or even with your fingers. A machinist's scribe with a bent end can be used to pull the lifters out by positioning the point under the retainer ring in the top of each lifter. **Caution:** Don't use pliers to remove the lifters unless you intend to replace them with new ones (along with the camshaft). The pliers will damage the precision machined and hardened lifters, rendering them useless.

9 Remove the two Torx bolts and the camshaft retainer plate, noting which direction faces the block (**see illustration**).

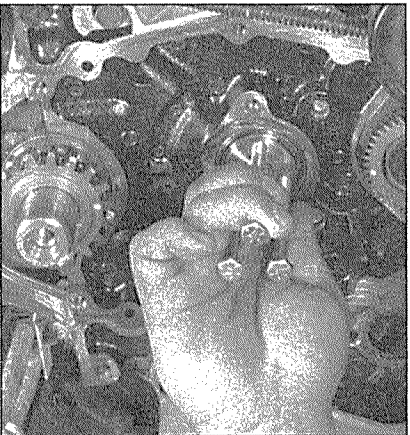
10 Thread three 6-inch long, 5/16-18 bolts into the camshaft sprocket bolt holes to use as a "handle" when removing the camshaft from the block (**see illustration**).

11 Carefully pull the camshaft out. Support the cam near the block so the lobes don't nick or gouge the bearings as it's withdrawn.

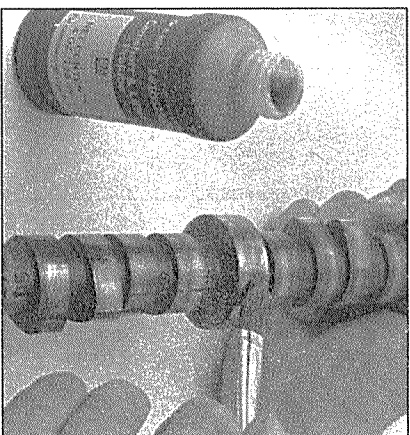
Inspection

12 Visually examine the cam lobes and bearing journals for score marks, pitting, galling and evidence of overheating (blue, discolored areas). Look for flaking of the hardened surface of each lobe.

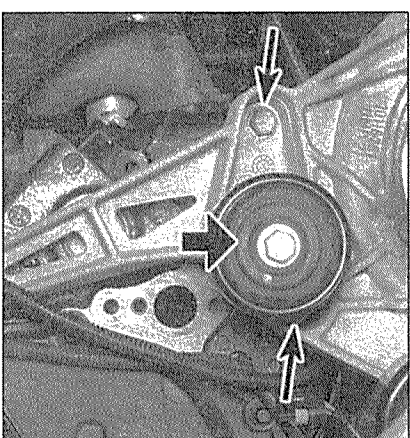
13 Using a micrometer, measure the diameter of each camshaft journal and the lift of each camshaft lobe (**see Chapter 2A**, Section 14). Compare your measurements with the Specifications listed at the front of this Chapter, and if the diameter of any one of these is less than specified, replace the camshaft.



10.10 Thread three long bolts into the camshaft to use as a handle - pull the camshaft straight out, without nicking the bearings



10.15 Lubricate the camshaft journals and lobes with camshaft and lifter assembly lube before installation to provide initial lubrication



11.4 On the right cylinder head, remove the air conditioning compressor/tensioner bracket - remove the three bracket-to-block bolts (small arrows); it's necessary to remove the idler pulley (large arrow) for access to one of the bolts

Bearing replacement

14 Camshaft bearing replacement requires special tools and expertise that place it outside the scope of the home mechanic. Take the block to an automotive machine shop to ensure that the job is done correctly. Refer to Chapter 2, Part C for bearing measurement and inspection.

Installation

Refer to illustration 10.15

15 Lubricate the camshaft bearing journals and cam lobes with camshaft and lifter assembly lube (see illustration).

16 Slide the camshaft into the engine. Support the cam near the block and be careful not to scrape or nick the bearings.

17 Turn the camshaft until the dowel pin is in the 3 o'clock position, and install the camshaft thrust plate, tighten the bolts to the torque listed in this Chapter's Specifications.

18 Install the balance shaft drive gear over the camshaft, aligning the dowel pin. Make sure the balance shaft timing marks are properly aligned (see illustration 9.11).

19 Install the timing chain and sprockets (see Section 9).

20 Lubricate the lifters with clean engine oil and install them in the block. If the original lifters are being reinstalled, be sure to return them to their original locations. If a new camshaft is being installed, install new lifters as well.

21 The remaining installation steps are the reverse of removal.

22 Before starting and running the engine, change the oil and install a new oil filter (see Chapter 1).

11 Cylinder heads - removal and installation

Note: The engine must be completely cool when the cylinder heads are removed. Failure to allow the engine to cool off could result in cylinder head warpage. When cool, refer to Chapter 1 and drain the cooling system.

Removal

- 1 Remove the intake manifold (see Section 6), and exhaust manifolds (see Section 7).
- 2 Remove the valve covers (see Section 3).
- 3 Remove the pushrods (see Section 4).

Right cylinder head

Refer to illustration 11.4

4 On models through 1998, refer to Chapter 3 and remove the air conditioning compressor. DO NOT disconnect the hoses from the compressor. **Warning:** The air conditioning system is under high pressure. DO NOT disassemble any part of the system unless the system has been depressurized. Remove the compressor mounting bracket and the belt tensioner (see illustration).

5 Disconnect the electrical connector from the knock sensor. On 1999 and later models, remove the alternator mounting bracket.

6 Remove the dipstick. Refer to Section 7 and unbolt and move the dipstick tube.

Left cylinder head

Refer to illustration 11.10

7 Remove the engine ground wire and electrical harness at the rear of the cylinder head.

8 Disconnect the electrical connectors from the knock sensor and the coolant temperature sensor.

9 On models through 1998, remove the alternator (see Chapter 5).

10 Unbolt and lay aside the accessory bracket retaining the power steering pump, without disconnecting the power steering hoses (see illustration).

Both cylinder heads

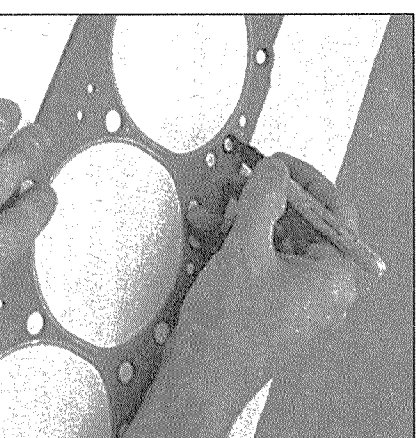
Refer to illustration 11.11

11 Using a new cylinder head gasket, outline the cylinders and bolt pattern on a piece of cardboard (see illustration). Be sure to indicate the front of the engine for reference. Punch holes at the bolt locations.

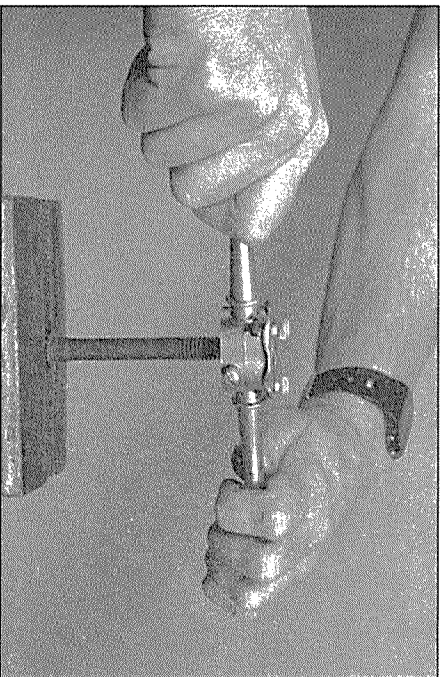
12 Loosen the cylinder head bolts in 1/4-turn increments until they can be removed by



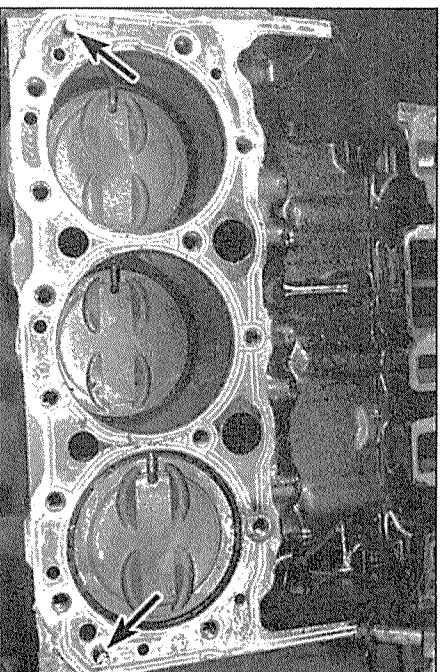
11.10 After removing the alternator and laying it aside, remove the accessory bracket from the left cylinder head. You may leave the power steering pump attached and set it aside without disconnecting the hoses



11.11 To avoid mixing up the cylinder head bolts, use a new gasket to transfer the bolt hole pattern to a piece of cardboard, then punch holes to accept the bolts



11.18 A die should be used to remove sealant and corrosion from the cylinder head bolt threads prior to installation



11.19a Locating dowels (arrows) are used to position the cylinder head gaskets on the block

hand. Work from bolt-to-bolt in a pattern that's the reverse of the tightening sequence shown in **illustration 11.22**. **Note:** Don't overlook the row of bolts on the lower edge of each cylinder head, near the spark plug holes. Store the bolts in the cardboard holder as they're removed; this will ensure that the bolts are reinstalled in their original holes.

13 Lift the cylinder head(s) off the engine. If resistance is felt, DO NOT pry between the cylinder head and block as damage to the mating surfaces will result. To dislodge the cylinder head, place a block of wood against the end of it and strike the wood block with a hammer. Store the cylinder heads on wood blocks to prevent damage to the gasket sealing surfaces.

14 Cylinder head disassembly and inspection procedures are covered in detail in Chapter 2, Part C.

Installation

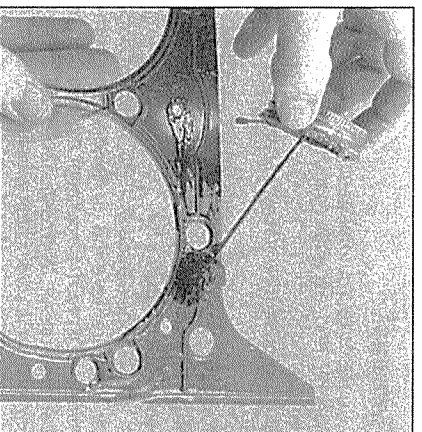
Refer to illustrations **11.18**, **11.19a**, **11.19b**, **11.21** and **11.22**

15 The mating surfaces of the cylinder heads and block must be perfectly clean when the cylinder heads are installed.

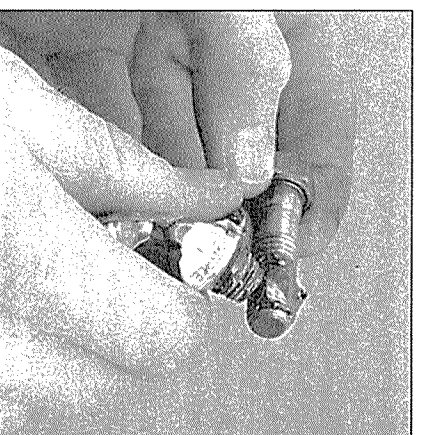
16 Use a gasket scraper to remove all traces of carbon and old gasket material, then clean the mating surfaces with lacquer thinner or acetone. If there's oil on the mating surfaces when the cylinder heads are installed, the gaskets may not seal correctly and leaks may develop. When working on the block, cover the lifter valley with shop rags to keep debris out of the engine. Use a vacuum cleaner to remove any debris that falls into the cylinders.

17 Check the block and cylinder head mating surfaces for nicks, deep scratches and other damage. If damage is slight, it can be removed with a file - if it's excessive, machining may be the only alternative.

18 Use a tap of the correct size to chase the threads in the cylinder head bolt holes. Mount each bolt in a vise and run a die down the threads to remove corrosion and restore the threads (see **illustration**). Dirt, corrosion, sealant and damaged threads will affect



11.19b Steel gaskets should be coated with a sealant such as K&W Copper Coat before installation - composite gaskets do not use sealant



11.21 The cylinder head bolts **MUST** be coated with a non-hardening sealant (such as Permatex no. 2) before they're installed - coolant will leak past the bolts if this isn't done

torque readings.

19 Position the new gaskets over the dowel pins in the block (see **illustration**). **Note:** If a steel gasket is used, apply a thin, even coat of a sealant such as K&W Copper Coat to both sides prior to installation (see **illustration**).

Warning: Composition-type gaskets are used on some engines, with a thin, sheetmetal core. Be very careful when handling because the edges may be very sharp. Composition gaskets do not require sealant.

20 Carefully position the cylinder heads on the block without disturbing the gaskets.

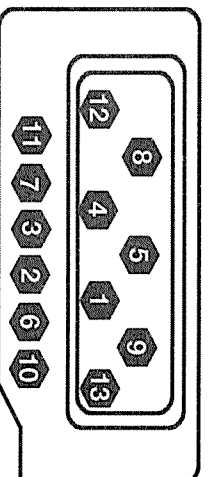
21 Before installing the cylinder head bolts,

coat the threads with a non-hardening sealant such as Permatex no. 2 (see **illustration**).

22 Install the bolts in their original locations and tighten them finger tight. Follow the recommended sequence and tighten the bolts in several steps to the torque listed in this Chapter's Specifications (see **illustration**).

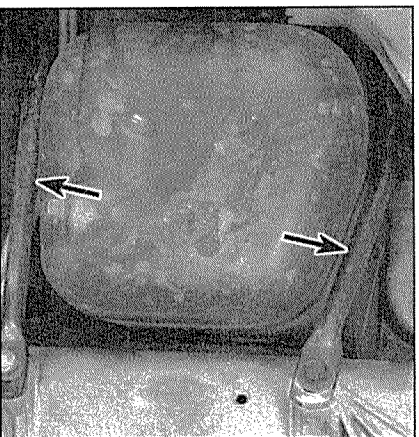
23 The remaining installation steps are the reverse of removal.

24 Change the engine oil and filter (see Chapter 1), then start the engine and check carefully for oil and coolant leaks.



11.22 Cylinder head bolt tightening sequence

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12.3 Remove the two braces (arrows) between the bellhousing and the engine

12 Oil pan - removal and installation

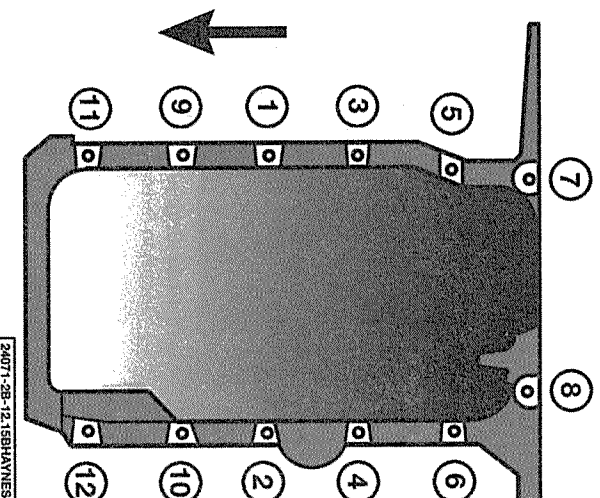
Note: On 2WD models it is necessary to remove the engine from the vehicle to perform this procedure (see Chapter 2C). On 4WD models, the front differential housing must be unbolted, moved forward and supported (see Chapter 8) and the engine must be unbolted from the mounts (see Section 16) and raised with an engine hoist to provide the necessary clearance for oil pan removal.

Removal and installation

1994 and 1995 4WD models

Refer to illustration 12.3

- 1 Disconnect the negative battery cable from the battery, then refer to Chapter 1 and drain the oil. **Caution:** On models equipped with a Delco Loc II audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery.
- 2 Remove the starter motor (see Chapter 5).
- 3 Remove the two engine to bellhousing braces and the cover from the lower part of the bellhousing (see illustration).
- 4 Separate the exhaust pipes from the manifolds (see Section 7).
- 5 Remove the oil pan mounting bolts/nuts. Most models are equipped with a reinforcement strip on each side of the oil pan which may come loose after the bolts/nuts are removed. Note the location of any studs and brackets before removing them.
- 6 Carefully separate the pan from the block. Don't pry between the block and pan or damage to the sealing surfaces may result and oil leaks could develop. You may have to turn the crankshaft slightly to maneuver the front of the pan past the crank counterweights.
- 7 Clean the gasket sealing surfaces with lacquer thinner or acetone. Make sure the bolt holes in the block are clean.
- 8 Check the oil pan flange for distortion, particularly around the bolt holes. If neces-



12.15 Bolt tightening sequence for the cast-aluminum oil pan

sary, place the pan on a block of wood and use a hammer to flatten and restore the gasket surface.

- 9 Apply a one-inch bead of RTV sealant at the corners of the block-to-front-cover joint and the rear-main-seal-to-block joint. Attach the new gasket to the pan.
- 10 Carefully position the pan against the block and install the bolts/nuts finger tight (don't forget the reinforcement strips, if used). Tighten the bolts/nuts in three steps to the torque listed in this Chapter's Specifications. Start at the center of the pan and work out toward the ends in a spiral pattern.

1996 and later models

Refer to illustration 12.15

- 11 A cast-aluminum oil pan is used on 1996 and later models that is designed as a structural reinforcement between the engine and transmission. It's alignment is critical. As with the previous models, the factory recommends removing the engine from the vehicle on 2WD models to remove the oil pan, and 4WD models can be done in-vehicle with the engine raised if the front axle is disconnected and pulled forward.

- 12 After removing the bolts (note the location of any studs and brackets before removal), separate the pan from the engine carefully. Do not use a pry tool between the block and pan or the soft aluminum of the pan can be gouged, leading to later sealing problems. Also, if a hammer and block of wood is used to break the gasket seal, use a rawhide or rubber mallet and only strike the pan where it is reinforced.

- 13 Clean the gasket sealing surfaces with lacquer thinner or acetone. Make sure the bolt holes in the block are clean and clean the pan's mounting surface, but do not damage the soft aluminum.

- 14 Apply a one-inch-long bead of RTV sealant at the corners of the block-to-front-

cover joint and the rear-main-seal-to-block joint. Attach the new gasket to the pan, install the pan and tighten the bolts/studs finger-tight.

- 15 The alignment of the rear face of the aluminum pan to the rear of the block is important. When done in-vehicle (4WD models) measure with feeler gauges between the rear face of the pan and the front face of the transmission bellhousing. Clearance should ideally be flush, but up to 0.010-inch is allowable. If the clearance is OK, tighten the pan bolts/studs in sequence to the torque listed in this Chapter's Specifications (see illustration). On 2WD models where the engine is out of the vehicle, use a heavy, precision steel straightedge held against the rear face of the block (bellhousing mounting surface) and measure between the straightedge and the pan for proper clearance.

- 16 The remaining steps are the reverse of removal. **Caution:** Don't forget to refill the engine with oil before starting it (see Chapter 1).

- 17 Start the engine and check carefully for oil leaks at the oil pan.

13 Oil pump - removal and installation

- 1 Remove the oil pan (see Section 12).
- 2 While supporting the oil pump, remove the pump-to-rear main bearing cap bolt. On some models, the oil pan baffle must be removed first, since it's also held in place by the pump mounting bolt.
- 3 Lower the pump and remove it along with the pump driveshaft.
- 4 If a new oil pump is installed, make sure the pump driveshaft is mated with the shaft inside the pump.
- 5 Position the pump on the engine and

make sure the slot in the upper end of the driveshaft is aligned with the tang on the lower end of the distributor shaft. The distributor drives the oil pump, so it is absolutely essential that the components mate properly.

6 Install the mounting bolt and tighten it to the torque listed in this Chapter's Specifications.

7 Install the oil pan and refill with fresh oil. The remainder of assembly is the reverse of the disassembly procedures.

14 Flywheel/driveplate - removal and installation

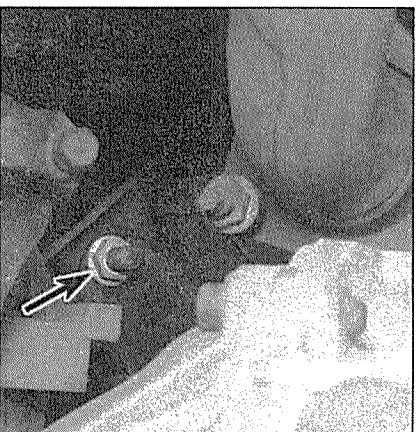
The flywheel replacement procedure is virtually identical to that of the 2.2L four-cylinder engine. Refer to Chapter 2, Part A for the procedure, and use the torque figures from this Chapter's Specifications.

15 Rear main oil seal - replacement

The rear main oil seal replacement procedure is virtually identical to that of the 2.2L four-cylinder engine. Refer to Chapter 2, Part A for the general procedure, and use the torque figures from this Chapter. Later model V6 engines have the rear main seal mounted in a seal retainer. The retainer has two slots on the edge where you can insert a screwdriver to more easily pry out the seal without damaging the crankshaft.

16 Engine mounts - check and replacement

1 Engine mounts seldom require attention, but broken or deteriorated mounts should be replaced immediately or the added strain placed on the driveline components may cause damage.



16.8a Engine mount through-bolt nut location (arrow) - left side (four-wheel drive model shown, with front driveshaft removed for clarity)



16.8b Engine mount through-bolt nut location (arrow) - right side, just above the starter motor

Check

- 2 During the check, the engine must be raised slightly to remove the weight from the mounts.
- 3 Raise the vehicle and support it securely on jackstands, then position the jack under the engine oil pan. Place a large block of wood between the jack head and the oil pan, then carefully raise the engine just enough to take the weight off the mounts.
- 4 Check the mounts to see if the rubber is cracked, hardened or separated from the metal plates. Sometimes the rubber will split right down the center. Rubber preservative or WD-40 should be applied to the mounts to slow deterioration.
- 5 Check for relative movement between the mount plates and the engine or frame (use a large screwdriver or prybar to attempt to move the mounts). If movement is noted, lower the engine and tighten the mount fasteners.

Replacement

Refer to illustrations 16.8a and 16.8b

- 6 Disconnect the negative battery cable from the battery, then raise the vehicle and support it securely on jackstands. **Caution:** On models equipped with a Delco Loc II audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery.
- 7 Attach an engine hoist to the top of the engine for lifting; do not use a jack under the oil pan or the oil pump pick-up could be damaged.
- 8 Raise the engine slightly, then remove the through-bolt nuts and withdraw the mount through-bolt from the frame bracket (see illustrations). Raise the engine further until the engine mount can be unbolted from the block.
- 9 Installation is the reverse of removal. Use Loctite on the mount bolts and be sure to tighten them securely.